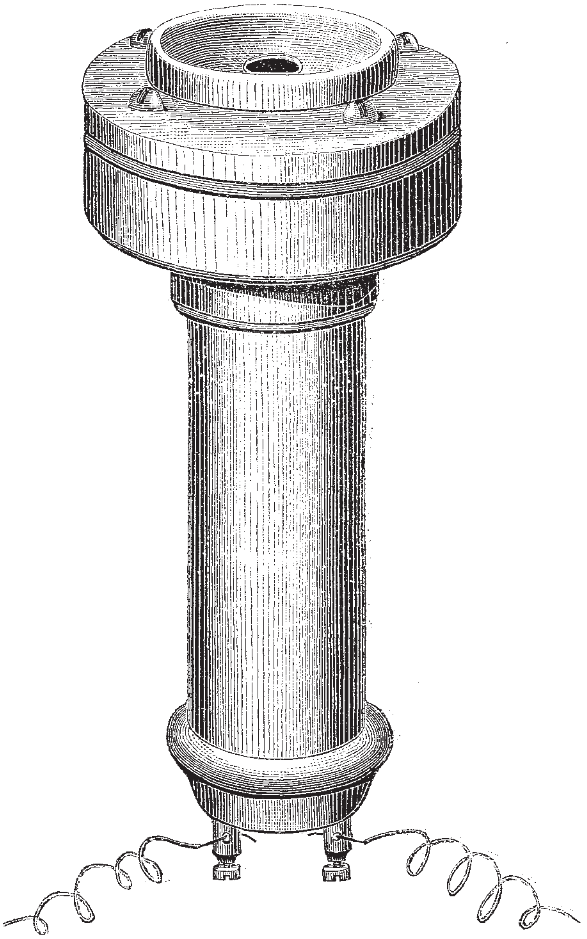
repeated on the diaphragm a with a strength and form that must vary exactly together. Hence, whatever sound produces the vibration of a is repeated by a^1, because its vibrations are an exact repetition of those of a.

It is quite evident, however, that Bell's telephone is limited in its range. The currents operating it are very weak, and it is so sensitive to currents that when attached to a wire which passes in the neighbourhood of other wires, it is subject to be acted upon by every current that passes through any one of those wires. Hence, on a busy line, it emits sounds that are very like the pattering of hail against a window, and which are so loud as to overpower the effects of the human voice.

Now Mr. T. A. Edison, of New York, has endeavoured to remedy these defects in Bell's by introducing a transmitter which is operated by battery currents, whose strength is made to vary directly with the quality and intensity of the human voice. In carrying out his investigations in this field he has discovered the curious fact that the resistance of plumbago varies in some ratio inversely with the pressure brought to bear upon it. Starting from Reiss's transmitter he simply substitutes for the platinum point (d) a small cylinder of plumbago, and he finds that the resistance of this cylinder varies sufficiently with the pressure of the vibration of the diaphragm to cause the currents transmitted by it to vary in form and strength to reproduce all the varieties of the human voice. His receiver also is novel and peculiar. In 1874 he discovered that the friction between a platinum point and moist chemically-prepared paper varied every time a current was passed between the two, so that the rate with which the paper moved was altered at will. Now by attaching to a resonator a a spring b, whose platinum face c rested on the chemically prepared paper d, whenever the drum e was rotated and currents sent through the paper, the friction between c and a is so modified that vibrations are produced in the resonator e, and these vibrations are an exact reproduction of those given out by the transmitter at the other station.



Bell's Articulating Telephone.[1]

Edison's telephone, though not in practical use in America, is under trial. In some experiments made with it songs and words were distinctly heard through 12,000 ohms, equal to a distance of 1,000 miles of wire.

Bell's telephone is, however, in practical use in Boston, Providence, and New York. There are several private lines that use it in Boston, and several more are under construction. I tried two of them, and though we succeeded in conversing, the result was not so satisfactory as experiment led one to anticipate. The interferences of working wires will seriously retard the employment of this apparatus, but there is no doubt that scientific inquiry and patient skill will rapidly eliminate all practical defects.

To Prof. Graham Bell must be accorded the full credit of being the first to transmit the human voice to distances beyond the reach of the ear and the eye by means of electric currents.

THE BRITISH ASSOCIATION

REPORTS.

Report of the Committee, consisting of the Rev. H. F. Barnes, C. Spence Bate, Esq., H. E. Dresser, Esq. (Secretary), Dr. A. Günther, J. E. Harting, Esq., J. Gwyn Jeffreys, Esq., Prof. Newton, and the Rev. Canon Tristram, appointed for the purpose of inquiring into the possibility of establishing a Close Time for the Protection of Indigenous Animals.—Your Committee begs leave to report that the object for which it was appointed continues to receive a considerable share of public attention, and that during the past year the three Acts of Parliament establishing a close time for certain kinds of birds have attracted so much notice that there is no fear of their falling into neglect.

There is no symptom of the diminution of the interest which the Sea-birds Preservation Act (1869) has always excited; and within the past twelve months application for the extension of the close time has been made, according to the provisions of that Act, by the Justices in Quarter-Sessions of Northumberland, Lancashire, and the North Riding of Yorkshire—facts which sufficiently speak for the general appreciation of the measure.

The Wild Birds Protection Act (1872) is possibly viewed by the public with greater favour than either of the others; but your Committee sees little reason to modify the opinion of it expressed in former reports. Nevertheless a conviction under it, presenting some rather important features, in May last, indicates that it is not so entirely useless as had been thought.

The Wild Fowl Preservation Act (1876) came into operation this year, and at first undoubtedly caused some discontent in many quarters, a warm discussion of its principle and provisions being raised by a portion of the public press. Your Committee, however, has noticed with much satisfaction that virtually no objection was taken to its principle, while the necessity of some enactment of the kind was conceded on almost every side. Furthermore, very nearly the sole cause of complaint lay in regard to the limits of the close time therein imposed, on which point no blame attaches to your Committee. The limits of the close time proposed in the Bill, as draughted by your Committee, and introduced into Parliament, were, as stated in last year's report, altered in its passage through the House of Commons; the change being such as your Committee then declared did not meet with its approval. Your Committee is therefore in no way responsible for the unseasonableness of the close time which was enacted, and believes that the soundness of its views on the subject is now generally admitted. In confirmation of this belief it may be stated that the Justices in Quarter-Sessions of the counties of Dorset, Norfolk, Kent, Somerset, Southampton, Wigtown, and Essex, have severally made application to the Home Office for such an alteration of the close time as will bring it more or less nearly in accordance with that originally proposed by your Committee.

Another charge was brought against this Act. It was alleged to be imperfect in that it did not expressly prohibit the possession or sale, during the close time, of birds of the kinds professedly protected, which had been imported into this country from abroad. This charge was supported by the dismissal (on the latter ground) by two magistrates of informations laid against certain poultrymen or game-dealers in London, and if it could have been sustained would undoubtedly have proved the Act to be defective. But the Royal Society for the Prevention of Cruelty to Animals appealed against one of these decisions; and on June 15 judgment was given in the Common Pleas Division of Her Majesty's Court of Appeal against the defendants in the case, thus proving that the legal interpretation of the Act agreed with the intention of its promoters.

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[1] This instrument was used by Mr. Preece in his experiments (see NATURE, August 23, p. 342).

Your Committee has satisfaction in finding that the Fisheries (Oysters, Crabs, and Lobsters) Bill passed the House of Commons on August 2, and it has now doubtless become law. It appears curious that no close time had hitherto been provided by the legislature for these important and favourite articles of food.

Having regard to the applications made from time to time to different members of your Committee by various persons interested in seeing the close time principle more widely applied, your Committee respectfully solicits its reappointment.

SECTION A.—MATHEMATICAL AND PHYSICAL.

PROF. S. HAUGHTON gave a summary of the first reduction of the tidal observations made by the recent Arctic expedition. The results arrived at were of great importance, and as far as tidal observations were concerned, the late Arctic expedition was a complete success; they also came in at the right moment for comparison with those made in the *Polaris* expedition. Lieut. Archer had charge of the tidal observations made on board the *Discovery*, and his notes were as complete and valuable as any he had ever examined. The *Discovery* was anchored at Bilhow Harbour; the *Alert* lay off Cape Sheridan, and was in every way less favourably situated for observing the action of the tides. The *Discovery* rose and fell with every tide, while the *Alert*, on the contrary, was surrounded by grounded ice of a formidable kind. Observations were made on board the *Discovery* every hour, instead of once in four hours, as required by the instructions. It was an unprecedented feat that during seven months observations were made every hour, and that there were only six days in the whole course of that time in which he had to interpolate coefficients. The *Alert's* observations required coefficients for fifteen days. The results obtained by Dr. Bessel from the *Polaris* expedition were confirmed by the English expedition, viz., that there was a junction of two important tides in the largest portion of Smith's Sound. The position of the *Discovery* was much nearer to the point of meeting, and this afforded another reason why her observations were more valuable than those of the *Alert*. It seemed that a new type of tide had been discovered, which could not be confounded either with that from Baffin's Bay or that from Behring's Straits, thus confirming Sir George Nares's opinion that Greenland is an island, as this new tide could only have come round from the east coast by a northern route. This stronger tide also presented a feature of great promise in tidal theory, indicating the probability of actual measurable tides occurring every eight hours. Dr. Moss, of the *Alert*, who was present, explained the very different conditions under which the two ships wintered.

Sir William Thomson read a joint paper by himself and Capt. Evans *On the Tides of Port Louis* (*Mauritius*) *and Freemantle* (*Australia*). The investigation had been undertaken in consequence of the recent Government grant for scientific researches. A sum of 200*l*. had been voted from this grant on the urgent representations of Capt. Evans and himself for the purpose of investigating the tides of the southern hemisphere, and making certain definite advances in the investigation of the tides in other parts of the world, particularly in the Mediterranean. The first proceeds of the work done was the present paper. The observations showed that there was a very near approach to equality between the solar diurnal tide and the lunar diurnal tide. The diurnal tide at Liverpool and Freemantle was about the same, but the semi-diurnal tide at Liverpool was about two hundred times as great at Liverpool as at Freemantle. He hoped that as the investigations were continued, they would be able not only to obtain scientific results but to obtain a practical way of giving tidal information in a form which would be useful to sailors—a desideratum that had not yet been obtained. Hitherto the theory of the Government had been that the information given in the Admiralty tide tables was sufficient for the practical purposes of navigation; and it was on that theory that Mr. Lowe, when Chancellor of the Exchequer, refused the application of the British Association for assistance in the matter. The fact was that the Admiralty tables did not give all that was necessary for the purposes of navigation, so that at all events the reason given by Mr. Lowe was a bad one. However the money had now been obtained from the Government grant of 4,000*l*. for scientific purposes; a grant, the working of which would, he hoped, more than fulfil all the aspirations of those who looked forward to it as a great boon to science, likely to produce results beneficial to the whole world.

Prof. G. Carey Foster gave an interesting paper *On the Mode of stating Certain Elementary Facts in Electricity*, and Mr. J. Traill Taylor described a binocular microscope of high power which Capt. Abney stated overcame the many difficulties in the way of obtaining microscopic pictures. Mr. S. P. Thompson exhibited some new optical illusions, which were much appreciated by the section, and also an improved lantern galvanoscope; and Messrs. C. H. Stearn and J. W. Swan exhibited a new form of the Sprengel air-pump. Among the other papers were *An Account of some Recent Advances in the Lunar Theory*, by Prof. J. C. Adams; *On the Eclipse of Agathocles considered in Reply to Prof. Newcomb's Criticism on the Co-efficient of Acceleration of the Moon's Mean Motion*, by Prof. S. Haughton; *On the Lower Limit of the Prismatic Spectrum*, by Lord Rayleigh; *On a New Unit of Light for Photometry*, by Mr. A. Vernon Harcourt; *On a New Form of Apparatus to Illustrate the Interference of Plane Waves*, by Mr. C. J. Woodward; and *On the Physical Properties of Solids and Liquids in Connection with the Earth's Structure*, by Prof. Hennessy. This last paper referred to experiments made by the author on the motion of fluids with a view to determine the conditions of viscidity and friction by which such motions are influenced. The principal results had been communicated to the Royal Irish Academy; the investigation had reference to Hopkins's theory of the great thickness of the earth's crust.

Mr. W. H. Preece gave an account of the telephone (which we give elsewhere), with illustrations, and this excited much interest in the section. On a later day Dr. J. Graham Bell, who arrived at Plymouth during the meeting, gave a series of experiments with the telephone before Sections A and G conjointly to a large audience; it is scarcely necessary to say that the telephone was the chief attraction of the meeting.

The supply of valuable papers in Section A was very good, and the meeting, as far as this section is concerned, was a successful one, though the attendance was not so large as last year at Glasgow. On account of the number of papers it was necessary to divide the section into two parts on Monday and Tuesday, Prof. Cayley and Lord Rayleigh being respectively the chairmen of the sub-sections on these days. On Monday the sub-section was occupied wholly with mathematics. There were papers by Prof. de Haan *On the Variation of the Modulus in Elliptic Integrals*, by Prof. Cayley *On a Suggested Mechanical Integrator for the Calculation of an Integral* $\int (X\,dx + \gamma\,dy)$ *along an Arbitrary Path*, by Mr. J. W. L. Glaisher *On the Values of a Class of Determinants*, and *On the Enumeration of the Primes in Burckhardt's and Dase's Tables*, by Mr. H. M. Jeffery *On Cubic Curves*, and by Sir William Thomson *On Solutions of Laplace's Tidal Equation for Certain Special Types of Oscillation*. Prof. J. C. Adams gave *An Account of his Calculation of the first Sixty-two Bernoulli's Numbers*. Only thirty-one had been previously calculated. Prof. Adams had also calculated the value of the sum of the reciprocals of the first thousand integers to 260 decimals, and thence, by means of the Bernoulli's numbers, the value of Euler's constant also to 260 places.

At the conclusion of the business of the section Sir William Thomson referred to the great loss the Association had sustained by the death of Mr. Gassiot, which took place on the first day of the meeting.

SECTION C.—GEOLOGY.

On the Exploration of some Caves in the Limestone Hills in Fermanagh, Ireland, by T. Plunkett.—This paper gave an account of trial explorations begun in the caves in question. They will now be carefully explored by a committee of the Association, aided by a grant from its funds. Large numbers of bones associated with human remains are found in cave-earth under stalagmite. The author also states that "a human jaw was found imbedded in glacial clay and associated with scratched stones." It is evident that the caverns here are of great interest and importance.

On the Origin and Antiquity of the Mounds of Arkansas, U.S., by Prof. J. W. Clarke.—The mounds vary from three to five feet high, and are from fifty to 140 feet in diameter. The author suggests that they were evolved from the simple carn-hillock by a race of men who followed the retreating glaciers.

A Short Sketch of the finding of Silurian Rocks in Teesdale, by W. Gunn, F.G.S.—It has always been believed that no rocks lower than the carboniferous limestone are exposed in Teesdale. The recent work of the Geological Survey has proved that certain peculiar beds at the Cronkley Pencil Mill are not carboniferous, but silurian. Messrs. Gunn and Clough have lately described these beds in a paper read before the Geological Society. The notes submitted to the Association record further discoveries of silurian beds near Widdybank Farm. They probably belong to the Stockdale series of pale slates.

Note on the Correlation of certain Post-Glacial Deposits in West Lancashire, by C. E. De Rance, F.G.S.—This paper described the post-glacial drifts of the Ribble Valley, and compared them with the drifts of the Lancashire Plain. The submerged forest of the coast and the peat of the plains are continuous with the peat of the valley. They contain beech-nuts. The Ribble has excavated its valley in glacial drift to a depth of from 150 to 200 feet; the sea at the same time has cut back the coast, forming a lowland plain on which the forest grew; subsequently the drainage became obstructed and the peat was formed. A subsidence of the land of some seventy feet or more submerged the peat and forest.

On the Influence of the Positions of Land and Sea upon a Shifting of the Axis of the Earth, by A. W. Waters, F.G.S.—The author pointed out how the unequal distribution of land and sea may be an agent in preventing the movements of elevation and depression of the land in one part of the globe, balancing those in another, and further showed how similar movements in various localities would differently affect the pole.

Any movement such as a submarine elevation which displaced water would spread it over the oceanic area, and the effect of this would, with the present configuration, be the same as if about one-twelfth of the weight had been added in the southern hemisphere along 45° 44′ long. E., viz., in a line passing by the entrance of the White Sea over the Caucasus through the middle of Madagascar.

As every submarine movement would create a force acting in this direction there seems reasonable ground for thinking the tendency would be for the shifting of the axis to take place near this line. Dr. Jules Caret considers that the pole must have moved approximately in a line passing through the meridian of 52° long. E., and what is cause, what effect, and how far they react on one another, is fully worthy of examination by any physical geologist.

The shifting caused by any elevation of land near the water or poles is very slight, so that the effect of the water displaced is up to about the fifth degree of latitude as great or greater than that caused directly by the movement of the land. From this it is apparent that near the equator a submarine movement may act on the pole in a contrary direction to that exercised by a similar movement nearer 45° lat. As about one-eleventh of the globe is included between the latitudes 5° N. and 5° S. the effects of the movements here are specially worthy of consideration.

The effects of the drying up of an ancient Caspian Sea was taken as an illustration of the points brought forward. The loss of water of double the area of the Caspian evaporating to a depth of about 200 feet would by the loss of weight of water, shift the pole about 166 feet towards the White Sea, but as this water would be so distributed as to cause additional weight along 45° 44′ long. E. in the southern hemisphere, it would shift the pole still further in the same direction, making a total of about 176 feet. If there were a Caspian Sea in the south along this line then similar phenomena would cause a movement of 156 feet as against 176 feet in the north.

On the Source and Functions of Carbons in the Crust of the Earth, by A. J. Mott.—Plants get their carbon from the air, and as carbon deposits in the earth's crust, from the graphite of the Laurentian to the Lignites of the Tertiary, are believed to be derived generally from plants, the origin of those deposits must be looked for in the source of the atmospheric supply. Calculations based on the reports of the Royal Commission on Coal, and other data, show that the average quantity of unoxidised carbon of vegetable origin in the earth's crust cannot be less, and is probably many times greater, than 3,000,000 tons per square mile of surface. This is 600 times as much as the atmosphere now contains in the form of carbon-dioxide, and if it had been drawn from an atmosphere originally charged with it to this extent, the oxygen liberated in the process would have been twice as much as now exists. As all animal life is destroyed by any considerable change in the constitution of the air; as it was abundant before the coal-formation, and as a great part of the carboniferous deposits are of later date, the theory becomes incredible. We are obliged to conclude that the carbon withdrawn from the air and returned to the ground by plants, has been annually supplied, and the liberated oxygen regularly removed, and the only rational explanation is found in the hypothesis that the oxygen and carbon are reunited; in other words, that carbon equal in quantity to the annual deposit is annually burnt underground.

The objection to this, founded on the small quantity of nitrogen in subterranean gases, is readily shown to be invalid. The annual deposit of carbon, which is a measure of the quantity annually burnt underground, is estimated at three cubic miles; the estimate being based on the annual produce and the known facts concerning its destination.

It is shown that by this process of oxidation and its physical consequences, the heat developed internally is probably equal to the annual loss, and that the earth, therefore, is not cooling. The extent of geological change thus accounted for is also considered, and the quantitative deductions are compared with known facts. It is concluded finally that the carboniferous deposits now existing can only be accounted for on the supposition of previous similar deposits, and consequently that nothing is known at present as to the origin of vegetable life, or concerning any period before it existed on the earth.

On the Occurrence of Pebbles in Carboniferous Shales in Westmoreland, by G. A. Lebour.—This was merely a note of occurrence of rounded and subangular pebbles of quartz or quartzite (which were exhibited) in a bed of carboniferous shale in Angill, Westmoreland. The pebbles were all of the same character, and were probably derived from some of the Lake District rocks and not from veins.

Notes on the Age of the Cheviot Rocks, by G. A. Lebour, F.G.S.—The Cheviot Hills consist of porphyrites, passing into granite and syenite; ashes and doleritic rocks also occur. These igneous rocks are newer than the silurians, on the denuded upturned edges of which they rest; they are older than the lowest carboniferous (or tuedian) beds of Northumberland, for these rocks are in part composed of porphyrite pebbles. This evidence fixes the age of the mass of the Cheviots as Devonian, or thereabouts. The author showed that on the south side of the Cheviots, near the head of Redewater, there are vesicular dolerites breaking through the tuedian beds; elsewhere (as in Punchestown Burn) there are doleritic breccias containing fragments of porphyritic and lower carboniferous rocks. We thus have evidence, in the Cheviot range, of rocks of probably Devonian, tuedian, and Bernician age, belonging to the same eruptive centre.

SECTION D.—BIOLOGY.

Department of Anatomy and Physiology.

ADDRESS TO THE DEPARTMENT BY PROF. MACALISTER, VICE-PRESIDENT.

AFTER referring to the strength and independence now possessed by the sciences of animal morphology and physiology, Prof. MacAlister referred to recent important advances in embryology. Among researches respecting the early formation and primary developmental changes in the egg, he alluded to those of E. van Beneden, Bütschli, Ihering, and Oscar Hertwig, classified under three heads. (1) What is the method whereby the stimulus to development directly operates on the egg; (2) What becomes of the germinal vesicle; and (3) In what manner and from what source the directive corpuscles arise, and what function do they serve in the animal economy. The next subject dealt with was the history of the primitive groove of the fertilised egg, as discovered by Dursy, Schäfer, Balfour, and Rauber. Prof. MacAlister could not but believe that a change had taken place in the position of the embryo on the surface of the germinal disc in the evolution of vertebrates, and that the primitive groove was the heirloom of this ancestral change. Coming then to the question of the origin of vertebrate limbs, the address referred to the researches of Balfour and others, showing that the limbs are the remains of continuous lateral fins. The professor then went on to say :—

The vertebrate animal is primarily composed of a chain of similar segments, and there is no *à priori* reason in morphology why any one metamere should not bear limbs as well as any other. Nay, from the analogy of chætopod worms we might expect that—as in these each zonite usually bears two pairs of parapodia or stumpy foot-processes—so in similarly derived and similarly segmented forms there might be at least traces of a similar multiplication of appendages.

In effect we really do find a somewhat parallel series in the metameres of fishes, for, as Mr. Balfour has shown, the medio-dorsal fin comes into existence precisely in the same manner as the lateral fin ridge, and being a double structure, as we learn, both in its specialised form and even in the structure of the cartilaginous precursor of the interspinous bones, it may reasonably be supposed to represent structures homologous with the system of notopodia in a laterally-compressed worm, fused together, while the paired fins may be regarded as the neuropodia, separated by the visceral cavity, and which, in the degraded and compressed metameres behind the visceral cavity, also coalesce, forming another primary ridge, that of the anal and caudal fin.

In relation to the primary source of origin and method of derivation of limbs we have to account for two separate factors, the limb-girdle and the limb-rays; with regard to the former I can now only refer to the hypothesis of Gegenbaur and Dohrn, that the limb-girdles represent modifications of the visceral arches, and I pass this by with two comments :—1. That the visceral arches are themselves to a certain extent specialised, and consequently it would be better to state the hypothesis thus, that the limb-girdles and visceral arches are specialisations of corresponding paraxial structures in different metameres. 2. In the light of the evident fundamental complexity of the limb-girdles it seems a simpler explanation of phenomena to regard each girdle as made up of the arches of several, probably three or more, metameres fused, rather than as subdivisions of a single arch.

As to the primary nature of the limb-ray, Professors Huxley and Gegenbaur have taught us in their recent reconstruction of the theory of the Archipterygium, that the primitive limb was constructed somewhat like the limb-ray of Ceratodus, having a central jointed axis from which diverge fore and aft lateral processes, or, to use the elegant nomenclature of Prof. Huxley, the primitive vertebrate limb consisted of a column of mesomeres, to each of which a lateral pre- and post-axial paramere was articulated.

But even this form, though doubtless the stock from which the limbs of all vertebrates above the Dipnoi have sprung, is regarded, and with reason, by Gegenbaur as a derivative one, formed by the coalescence of a still more archaic arrangement of rays appended to the paraxial arches referred to above. It is possible that the primary fusion may have taken such a form as that which Gegenbaur represented in his original Archipterygium with more than one cartilage appended to the girdle, a form of which the arrangement in the dogfish and angel-shark may be representative, and these, by a still farther concentration, attended with an exaltation of the mesopterygium and a displacement of the propterygium as in Hexanchus, or of the pro- and metapterygium as in Cestracion, may thus reach the elongated form of the limb in Dipnoi. It seems obvious that this fish Ceratodus, though singularly generalised, has arisen from a point in the vertebrate stem above the starting-point of the elasmobranchs.

Whether this has been the case or no, whether the elasmobranch has been derived from an earlier condition than the dipnoan progenitor or no, the researches of Prof. Huxley have made it plain that it is from the meso-, and not from the metapterygium that the single basal ray bone of the higher vertebrates has arisen.

A curious question will naturally occur to any one considering the genesis of limbs, What is the reason that in vertebrate animals the number of limbs is limited, and apparently has been always limited, to four? and as we have seen that there is an ontological possibility that each of these contains elements from several metameres, there is no morphological reason, and therefore must be some mechanical cause for this limitation. Were the primitive vertebrates terrestrial we could understand that the tetrapod has a mechanical advantage over the tripod or any condition with an inferior number of limbs, both statically from the indeterminateness of the strain on each support in the four-legged form, and in progression, from the easily understood conditions of stability of equilibrium in walking; while the tetrapod excels the hexapod or millipede not only because, by a reduction in number, the amount of nutrition required for the use of the limbs is minimised, but it is absolutely demonstrable that the facility of rotation is increased by the reduction of the limbs to the lowest number consistent with other conditions of utility. In connection with this point Prof. Haughton has made some curious observations, the results of which I hope we shall have laid before us in this department during our present meeting.

But the earliest vertebrates were aquatic, and yet even here we find the four-fold division of these actival appendages. These primitive forms differed from worms, in the greater amount of fusion of their metameres, which at an early period had ceased to give to these animals an externally jointed appearance, so we may learn from Amphioxus, which has branched from the vertebrate stem long before most of the secondary characters, which are constant throughout the rest of the vertebrates, had been foreshadowed. Being thus more consolidated than worms, and moving, as they would necessarily do, more as a unit and less as a chain, the advantages of the mode of propulsion by a tail, over swimming by means of the continuous lateral fin of united parapodia, would be increasingly manifest with increasing somatic rigidity. Hence, naturally, the parapodia of the hinder somites would coalesce to form a tail as they have done in fishes, and the appendages placed farther forward would undergo retrogression unless some function could be found for them which would make their retention an advantage in the economy. In the long worm-like forms like lampreys, such a retrogression has absolutely taken place, as in fishes of this form the use of lateral fins is reduced to a minimum; hence in the elongated form of ordinary fishes, like eels, band fishes, and blennies, the lateral fins become rudimental or varied. But these organs are of obvious use in giving a capacity to alter the plane of motion, a power which is necessary for most fishes, as they only act in elevation and depression but in lateral rotation, as any one can verify for himself by watching fishes in an aquarium. In order to accommodate these united lateral appendages most conveniently to the sinuous curves into which the body of a fish is thrown in swimming, and to diminish the surface of resistance to the water, the parapodia have divided themselves into two groups, leaving the centre of the body, where the cephalic and caudal curves meet during progression, free from lateral appendages.

The address concluded by a brief notice of work in human anatomy. It was remarked that much remained to be done in details even in this well-wrought department. We had not available correct and broadly based statements regarding the average conditions of the variable parts of the human body. Considering that something like six hundred bodies were annually dissected in Great Britain and Ireland, such a basis ought to be easily attainable. In such work Prof. Wenzel Grüber, of St. Petersburg, the prince of descriptive anatomists, was laborious and indefatigable. Yet still much remained to be done to make human anatomy a really scientific study, a practical application of morphological principles.

One of the features of this department was Prof. Haughton's discourse on the best possible number of limbs for an animal. The criterion was the most economical expenditure of force, according to mathematical principles. With regard to land animals, it was shown that the three-limbed vertebrate is superior to two and one-limbed forms, being perfectly stable when resting on the limbs. The four-limbed vertebrate, however, was able to preserve perfect stability on any three of its limbs, while using the fourth for offence. There was for the most part no advantage in having five or a greater number of limbs, the cost of feeding the extra limb outweighing the advantage of possessing it. Arboreal animals developed the tail as a fifth limb because of its special advantage in the medium in which they lived. Man gave up the superior stability of having four limbs for support in exchange for two adapted to higher uses, and in correlation with his brain-power. In discussing the limbs of aquatic animals, Prof. Haughton showed how advantage in the use of force and in directing motion was gained by concentration of motor power and limitation of the number of limbs. The three-limbed and one-limbed swimmers had advantages over all others, and odd-limbed forms over even-limbed. In many respects the three-limbed swimmers were superior to the one-limbed, but the latter had the valuable quality of being able to apply a maximum force in one direction, and so escape from their enemies. Prof. Haughton indicated fishes as really possessing one principal limb in the tail, the fins being only capable of exerting a very slight force when compared with the tail.

The Rev. W. H. Dallinger described some of the processes and results of his investigations into the life-history of the simplest organisms. Among the points especially dwelt upon were the development of four out of two flagella in his calycine monad after fission; the determination of the diameter of the flagellum of *Bacterium termo* to be the two hundred and ten-thousandth of an inch; and special contributions to the spontaneous generation question. Although the life-histories of the forms examined were perfectly definite and distinct, yet the result of his investigations was to give a conviction of the truth of Darwinian principles among simple forms at any rate. He mentioned as a contribution to physiology the discovery that so highly organised an Infusorian as Paramecium could live for a long period in Cohn's (inorganic) solution. An important series of experiments had been conducted with regard to the extent of the adaptability of monads to changed conditions of temperature. It had been found that they could, by gradual increments, be raised from a temperature of 45° to one of 125°, and live and multiply perfectly; but a sudden transition of a much smaller extent was immediately fatal, as was also a sudden fall of temperature. Another series of inquiries showed that it took much longer to produce a modification in the ovum or germ than in the adult.

Prof. Rolleston, in a paper *On the Vascular Supply of the Brain*, ascribed right-handedness to the greater vascularity of the left side of the brain. He further speculated on the probable entire disappearance of the occipital lobe of the brain on account of its deficient relative supply of blood. Prof. Allen Thomson called attention to a remarkable series of photographs, many applicable to the stereoscope, representing the blood supply of various parts of the system. They were executed under the superintendence of Prof. Dantscher, of Innsbruck, from preparations made by himself. Dr. W. H. Pearse read a paper *On the Geography of Consumption in Devonshire*, claiming to demonstrate that the wildest moorland districts had the lowest death-rate from that disease. While England and Wales showed a rate for consumption of 2·47 per 1,000, the rate for western Dartmoor was 0·37, and for the west of Exmoor 0·45. This was notwithstanding the great rainfall.

Mr. G. T. Bettany gave a summary of the conclusions as to the structure and interpretation of the vertebrate skull, contained in the work on the Morphology of the Skull, just published by Prof. Parker and himself. The nature of the trabeculæ and the segmental relations of the skull were especially dwelt upon. In another paper Mr. Bettany advocated the harmonisation of animal and vegetable physiology, by the use of terms in the same sense in both, referring especially to the term assimilation, now so vaguely and discordantly employed in the two sciences. Among other papers may be mentioned Prof. McKendrick's *On the Physiological Action of the Substitution Compounds of Pyridene and Chinoline*, and Dr. Cunningham's, *On the Muscular and Nervous Systems of several little known Marsupials.* Only a small number of anatomists and physiologists were present, and the paucity of papers in physiology was ascribed to the discouragement and hindrance to experimental research caused by the vivisection controversy.

Department of Anthropology.

No striking novelty was brought forward in connection with the geological evidences of the antiquity of man. Various local discoveries of flint implements were noticed, the occurrence of flints in Cornwall and the Scilly Islands being of especial interest, owing to their distance from the chalk. Mr. John Evans described some palæolithic implements from the valley of the Axe, made of chert from the Blackdown beds, proving that where chalk flints were scarce, other siliceous rocks were utilised by palæolithic men for the same purpose. Mr. Widger's collection of extinct mammalia from Newton Abbot caves, as yet only imperfectly explored, excited much interest. Mr. Laws gave an account of a cave at Tenby containing a rich aggregation of extinct mammalia, and recommended the Welsh coast as a rich hunting-ground for anthropologists. Prof. Rolleston and Col. Lane Fox described their exploration of tumuli at Sigwell in Somersetshire, and near Guildford. The co-existence of different styles of interment among a people was confirmed by these researches. Prof. Rolleston's address *On our Knowledge of the Flora and Fauna of Prehistoric Times* was very attractive. In the course of his remarks on trees he noticed that remains of the ash were found in English but not in Scotch peat; the beech again was absent from Scotch peat. With regard to bees and bee-keeping, he said the only certain fact known in relation to the question where and when hives were introduced, was that in all cases the word for hive was allied to the Latin word for it. He thought honey became important very early, as a source of sugar; especially to people who had neither the sugar-cane nor beet-root. He believed great changes had taken place in British mollusca since prehistoric times. The so-called Roman snail was without doubt a very old and well-established British snail; while a little snail most abundant at present was not known in prehistoric deposits. He thought there were the best grounds for believing the rabbit not to be prehistoric in this country. In an old tumulus Prof. Rolleston had found several handfuls of jawbones of the common water vole, and not far off a large canine of a pol-cat, which had evidently made its nest in the tumulus and fed its young upon water-rats. These are but a few out of many most interesting facts mentioned in the paper. Mr. Spence Bate's description of the prehistoric remains on Dartmoor, visited by an excursion party, was another subject that attracted much attention.

There were a number of valuable papers on the habits, history, &c., of uncivilised peoples. Miss Buckland's paper *On the Stimulants of Ancient and Modern Savages* showed how in all parts of the world, as soon as agriculture was established, people began to make fermented drinks from the roots or grains cultivated for food. But it further appeared that still earlier stimulants were leaves and roots that when chewed were found to produce exhilaration. With the dawn of civilisation these roots and plants were steeped in water, inducing some fermentation. Later the cereals were used, the roots and plants being still retained for flavour and to produce fermentation. The juice of the grape became employed at a subsequent period still. Mr. Bertram Hartshorne read a valuable paper *On the Ancient People of Ceylon*, giving an account of their history as far as it could be gathered, giving many evidences of retrogression among them. The Rev. S. J. Whitmee, the well-known London Society missionary, gave some account of the Malayo-Polynesians, with abundant proofs of their degradation from a higher social and intellectual level. Among these were the comparatively high social position of the women, the existence of hereditary rank and titles, the tenure of landed property, the systematic division of land, and their poetry. Mr. F. M. Hunter described the peculiarities of Socotra Island. In reference to the Bedouin inhabitants, he said that religion seemed to sit lightly upon them. They only prayed when they had an audience, and even in the very act of prostration they would turn round, join in conversation, and again continue their devotions. The mark of the cross was still used on the head-stones of the graves. Mr. A. Simson's paper *On the Zaparos Indians* contained a great deal of curious information.

Coming to regions nearer home, Dr. Beddoe endeavoured to trace the history and ethnology of the Bulgarians, but confessed that much was still unknown on the subject. Although they spoke Sclavonic they did not appear to be really Sclavs or even Turanian. The original Bulgarians were a tribe from the Volga region, probably connected with the Huns. Dr. Beddoe believed that the present Bulgarians were as much Ugrian as anything; they were evidently prognathous. The Rev. W. S. Lach-Szyrma in discussing the Cornu-Britons, divided them into two classes, those who came there under pressure of Saxon invasions, and those who came as immigrants to the coast districts. He did not believe in any Semitic admixture.

The report of the Anthropometric Committee spoke of the serious difficulties attending its observations in the attainment of uniformity and accuracy. Mr. H. C. Sorby described the several different colouring matters he had derived from human hair, the chief being a black pigment and a reddish-brown substance. Very red hair contained a small quantity of pink-red substance. A noteworthy opinion given by Mr. Sorby was that he did not think it possible that hair could change colour in a single night. Other interesting papers were by Prof. Rolleston *On Artificial Deformations of the Human Head* and *On the Rationale of Brachycephaly and Dolichocephaly*, by Dr. Phené and others. Altogether the department sat on five days, and exhibited much vigour; both papers and discussions were very attractive, although the amount of novelty in regard to primitive man and his relations to geological history was not great.

Department of Zoology and Botany.

In this department the greatest general interest was excited by Mr. McLachlan's paper *On the Colorado Beetle*. He gave a most valuable account of its natural history, and then proceeded to remark on the panic respecting its introduction into England. He approved of restrictive legislation, but said it was as much needed four or five years ago as now. He believed if the beetle could have been introduced if would have been ere now, not so much among potatoes, which were mostly imported from America for seed, in a very clean state, or through the reception of specimens by scientific men, as in a promiscuous manner in general merchandise, owing to its great abundance on the quays of New York, &c. But there was much reason to expect the beetle could not readily be acclimatised in our moist climate. American animals in general failed to spread in Europe. Moreover, Great Britain possessed many insectivorous birds which had no representatives in the United States.

Prof. McNab read several important papers on botanical subjects. One, *On the Movement of Water in Plants*, gave an account of researches by Professors Pfitzer and Hoehnel, continuing and confirming results arrived at by his own investigations. Prof. McNab also brought forward a revised classification of plants, in which he adopted the term Order for the larger groups sometimes called cohorts, and in which the apetalæ were distributed among the petaloid orders to which they are allied. He further gave a synopsis of the present knowledge of fossil flowering plants, showing that Haeckel's postulates as to the evolution and period of first appearance of flowering plants were already shown to be false by new discoveries. It appeared, on the whole, that the gamopetalous forms arose later than the dialypetalæ. Prof. McNab inclined to the opinion that while the monocotyledons were monophyletic, or arose through one line of descent, the dicotyledons were polyphyletic, or derived from several main stocks.

Other papers of interest on botany were by Prof. Dickson, *On the Structure of the Pitcher of Cephalotus*, and by Mr. A. S. Watson, *On Structural Characters in Relation to Habitat in Plants*.

Prof. Rolleston described several features of interest in the zoology of New Guinea, especially the new Echidna, of which he had received a specimen. He detailed the evidences of the former connection by land between New Guinea and Australia, and accounted for the divergence between the vegetation of the two by influences due to the high mountains of New Guinea and the great barren plains of Australia. Mr. W. Ackroyd read a paper *On the Colours of Animals*. A contribution was read from Dr. Otto Finsch, giving the results of the North German Exploring Expedition to Western Siberia. Dr. G. Bennett, from Australia, gave an interesting account of the habits of the pearly Nautilus.

SECTION E.—GEOGRAPHY.

In this Section, presided over by Admiral Sir Erasmus Ommanney, the president's address consisted of a *résumé* of geographical discovery during the past forty years. Among the papers read none were of special interest.

Major Wilson read a paper by Lieut. Kitchener, R.E., *Report of the Line of Levels from the Mediterranean to the Sea of Galilee.* The levelling commenced in June, 1875, but was soon interrupted by local circumstances. It was resumed in March, 1877, and carried to a successful conclusion by Lieut. Kitchener. There had, as yet, however, been no opportunity of applying corrections. The result of the work showed the depression of the Sea of Galilee to be 682·544 feet. Fortunately they had a perfectly calm day for securing the sea-level. The sea left a clearly-defined white mark at its highest part; the depression shown by Kitchener's observations was some forty or fifty feet greater than had been generally supposed. The depression of the Dead Sea was 1,292 feet, which gave to the Jordan a fall of a little over 600 feet; this fall was nearly even throughout, although there were one or two rapids in its course. The deepest part of the Jordan Valley would be 1,300 feet below the level of the Mediterranean.

Commander Cameron read a paper *On the Proposed Stations in Central Africa, as Bases for Future Exploration.* He thought the best means for the exploration of the continent would be the establishment of trading societies after the fashion of the East Indian and Hudson's Bay Companies, but the spirit of the age was against the granting of sovereign powers to commercial companies. That being so, he considered a system of central stations, placed at intervals of from 200 to 250 miles distant, the best available. The new stations should be placed under the charge of a consul or a vice-consul, or of consular agents, but if the British Government hesitated to undertake the responsibility, the Seyyid of Zanzibar should be asked to accept it, and he believed most of the traders and shyas would recognise the authority of his highness. The stations might be turned to account, not only for the purpose of map-making, but of ascertaining the commercial value of the surrounding districts, obtaining meteorological observations and botanical and zoological collections, accustoming the neighbouring populations to the nature and advantages of civilised rule, systematically extirpating the slave trade, and diverting the traffic now employed in this infamous trade to the development of the enormous national wealth of the continent. In concluding, Commander Cameron made an appeal on behalf of the British Society for African Exploration. He warned his audience that unless Britain speedily bestirred itself it would lose the pre-eminence it long enjoyed among the countries of Europe. At the call of its sovereign the little kingdom of Belgium had contributed 12,000*l.* for the fitting out of an expedition. Portugal had contributed 20,000*l.*, and he hoped the British public would not fail to do their duty as respects the opening up to civilisation of Africa. The more rapidly the light of civilisation is introduced into the continent the more rapidly would the slave trade and domestic slavery die away and become a thing of the past.

A paper by Mr. W. H. Tietkens, *On the Latest Exploring Expedition across Australia*, was read by Mr. Bates. It described the journey made in 1875 by Mr. Ernest Giles, accompanied by the author of the paper and by Mr. Young, from the settlements of South Australia to those of Western Australia. The result of the journey was the conclusion that the occupation of some portions of the country cannot be long delayed, being well adapted for wool growing, but the writer confirmed the opinion expressed by other travellers that the region between lat. 21° and 30°, and long. 123° and 132°, can never be colonised, and that any white men settling in it would become like the wandering nomads now inhabiting it. The expedition was most adventurous owing to the attacks made upon it by some of the natives, and also to the difficulties arising from scarcity of water, which, at one time, threatened to terminate the career of the travellers.

Mr. Trelawny Saunders called in question the conclusions come to by the author of the paper as to the future of Australia, and said such a future would be a serious matter for Plymouth, which was one of the great ports of emigration to Australia. He placed against this opinion the authority of Mr. Landsborough, who had recently described the great physical changes taking place in the Australian continent, in consequence of the occupation of it by our countrymen. Trees were growing where none were previously to be seen, the natives being prevented from burning the long grass for the purpose of getting game. The growth of forests would cause a greater rainfall, and lead to the improvement of the productive qualities of the country.

Col. Godwin-Austen read a paper *On the Course of the Brahmaputra or Sanpu.* The author's argument, founded on researches and surveys in Assam, was that the true outlet of this great river was by the Sukushiri, and not, as was generally supposed, by the Deipong.

THE FRENCH ASSOCIATION AT HAVRE

HAVRE, *August* 30

THE final meeting took place this afternoon at 2 o'clock, under the presidency of M. Broca.

Montpellier has been selected as the place of meeting for 1879. The University of Montpellier has been for centuries a rival to Paris, and even now is bold enough to compete with its formidable rival. Montpellier is also notable as the birthplace of Auguste Comte, the founder of Positivism. A number of scientific gentlemen have subscribed a large sum to receive the Association in 1879; the General and Municipal Councils will also vote a large sum.

It has been suggested by some influential members that the meeting of 1880 should be held in Algeria. But the vote will not be taken till next year at Paris. The year 1880 is the fiftieth anniversary of the conquest of Algeria. There are at the present time very few scientific institutions in the colony. Should the choice be made, the Algiers Academy would probably be then transformed into a University for Algeria.

The Association, at the close of the Havre meeting, has voted